of reducing the harm thereof to a minimum. By prolonging the time in which the upper portion of the ingot solidifies, the piping is located* at the top of the ingot and can be removed therewith. In order to achieve this in large ingots (over five tons) the upper portion of the mould is lined with a refractory material, which is preheated before casting, and thus absorbs much less heat from the molten metal than the walls of the chill mould beneath this. Further, the head of the ingot is maintained molten as long as possible by means of a gas flame or by so-called " pipe thermit," and feeding by means of hot molten steel as the molten metal sinks by contraction on solidification of the body of the ingot. Further detail as to this matter is to be found in Ledebur's " Eisenhuttenkunde," Vol. III., p. 237, re Kleiner's Process; also " Stahl und Eisen," 11)07, pp. 1119 et seq. A. Obholzer, " Prevention of pipe formation by employment of ' Pipe Thermit,' " and Ledebur, p. 245, " Hermet process," in which steel ingots are rendered, by means of presses, sound and of reduced dimensions.

No process which ensures practical results has yet been found for prevention of formation of pipe, in small ingots, and one must, therefore, be confined to employment of the proper casting temperature and thereby hindering the piping from attaining too great dimensions.

The phenomenon of segregation takes place parallel with the piping, that is to say, the separation of material which differs in its composition from the average composition of the material emplo3Ted, and actually contains the impurities of the iron in much larger amounts. Segregation makes itself the more perceptible the greater the dimensions of the masses of steel, and it makes its appearance exactly like the pipe formation in the places which last remain liquid. It is hence possible in the main to limit them to that portion of the ingot which is later removed ; that is to say, to tlio so-called " head." Moreover, one can thus make them less sensible, so that only the purest possible steel is produced.

The peculiarities of piping and segregation mentioned only make their appearance as described if the metal solidifies without evolution of gas. They may be partly or wholly covered up in other cases. Formation of gas on solidification